extending from Patagonia to Alaska and from Kamchatka far down along the Pacific coast of Asia, have long been recognized as showing that we have here a part of a great circle around the Pacific representing a belt that is unable to withstand the great strain produced by the tidal action of the sun and moon. The strata of this belt have, therefore, for a long time been gradually crumpling, while the bed of the Pacific has been alternately rising and falling as it rested on the viscous interior of our globe. These oscillations of the Pacific Ocean must have affected the level of the Atlantic. They could change the axis of rotation of the globe only a very few degrees, but affect local climates directly, causing great oscillations in altitude, temperature, and moisture, with only small changes in the general circulation of the atmosphere. The conditions that now produce glaciation in New Zealand, Greenland, Alaska, Switzerland, and Iceland appear to have once prevailed in the Himalayas, the North American Lake region, central Africa, and Scandinavia during the many changes that have been taking place in the orography of the earth's surface. The fundamental condition producing glaciation is simply the ratio between the snowfall of the cold season of the year and the heat, wind, evaporation, and rainfall of the warm season. If the latter agencies are sufficient to melt the winter's snow, then no glacier occurs. As illustrative of this point, it may be well for some one to construct maps of the globe analogous to that which was prepared by me for a lecture in Baltimore in 1898, showing the average total snowfall during the winter seasons of 1884–1895, divided by the average total rainfall of the year. Of course one must take into account the temperature of the rain water and the evaporation from a dry snow surface, as well as the melting of the snow in the sunshine. Our map therefore gives only the crude elements of the problem, but practically the coefficients must be determined meteorologically, by studying the actual records of snow on ground in regions where glaciers now occur.

As concerns the changes of climate in Asia Mr. Ellsworth Huntington, who has been studying in person the physiography of that continent, has discovered what he believes to be conclusive evidence of great changes in the direction of dessication during the last two thousand years. He has brought together conclusive data showing the drying up of rivers and lakes and the retreat of their shores to distances of fifty or a hundred miles. The great caravan routes from China westward have also been changed from time to time owing to the necessity of following the water routes. The area of dessication extends from the Caspian Sea eastward for over twenty-five hundred miles. Mr. Huntington, in fact, seems to maintain that there have been alterations of dry and wet centuries, three such alternations since the year 800, with a long period of abundant rain previous to that. Without discussing his definite epochs we may in general conclude that in the present state of the globe and the atmosphere, and without any change in latitude or altitude, moisture or sunshine, it is perfectly possible for such combinations of winds to occur as to give us in one century conditions favorable for rain, snow, and glaciers, but in another distant century drought, sand, and desert. These alternations depend essentially upon extreme variations in what is called the general circulation of the atmosphere; they are perturbations produced solely by its own internal mechanism. We are familiar with such alternations every six, eight, or ten years in most countries. Brückner has submitted arguments in favor of changes at irregular intervals, averaging thirty-five years, in Europe, while Russell maintains a periodicity of nineteen years in Australia. But the motions of the atmosphere are too irregular to be properly styled periodic; a combination that will occasionally recur so as to give a drought in the United States may do so at very irregular intervals, and no matter whether the average interval is seven, nine, or thirty-five years, it should not be spoken of as periodic. The main point for us to remember is that where now we have droughts once there was abundant rain; where now we have arable land once there were glaciers; and these climatic changes are recurring without any notable change in surrounding conditions. They are the result of the innumerable combinations that may arise, some favorable and some unfavorable; and they will be exactly explained when we fully understand the mechanics of the atmosphere as it now is.—*C. A.*

TORNADOES OF JUNE 6, 1906, IN MINNESOTA AND WISCONSIN.

Referring to page 274 of the MONTHLY WEATHER REVIEW for June, 1906, the Editor has received a report written by the late Mr. T. S. Outram, in which he gives some account of the tornadoes which occurred on June 6, 1906. The following brief extracts are sufficient to locate these tornadoes, but many details are given in the manuscript:

Late in the afternoon of June 6 tornado conditions were evident at many places in eastern and southeastern Minnesota and western Wisconsin, with actual tornadoes occurring in Houston and Chisago counties, Minn., and La Crosse, Monroe, and Vernon counties, Wis.

The Chisago tornado evidently developed between Forest Lake and Wyoming, and moved nearly northward some 35 miles to near Harris. The width of the track of greatest destruction varied from 50 feet to about a quarter of a mile.

The effects of the Houston tornado[1] were felt over a wide area, but the storm was most severe between Freeburg and Reno, a distance of about six miles. From Reno the storm seems to have past over the Mississippi River to near Stoddard, Wis., but from Stoddard to Leon, a distance of about fifteen miles, the great force of the tornado was again exerted.

In both these storms the funnel-shaped cloud was present; it was very black, showed a violent whirl in which there was much débris, and toward which the clouds seemed to rush from all directions; the lower end of the funnel whipt about, destroying everything it came in contact with. The wreckage of the buildings and timber seemed to be thrown in all directions, but a few persons thought they noticed that the whirl of the storm was in a direction opposite to that of the hands of a watch. There were heavy rains after the passage of both tornadoes, and in places there were very large hailstones. The noises are said to have been very distinct, resembling the rumbling or roar of a long train of cars.

The characteristic freaks or strange happenings so common in tornadoes were present in these storms also, and a few may be mentioned. A kitchen cupboard, filled with china, standing in a house which was completely torn to pieces, was carried four rods and set down so gently that not a piece of the china was broken. When the storm struck the Inglett place Mr. Inglett, sr., was sitting in the kitchen with a child on his lap; the house was completely demolished, even to the carrying away of nearly all the floor but that on which the man was still sitting uninjured after the storm past. Articles of furniture were carried 4½ miles from their starting point. The rung of a chair was driven thru a large tree, so that its ends projected from each side.

MR T. S. OUTRAM.

Mr. Thomas S. Outram, in charge of the Minnesota Section of the Climatological Service of the Weather Bureau, died at his post of duty, in Minneapolis, Minn., December 5, 1906.

Mr. Outram was born at Elmira, N. Y., May 26, 1856. His education in public and private schools at Easton, Md., was supplemented by an attendance of eighteen months at Cornell University. He entered the weather service of the Government (Signal Corps) in March, 1879. After serving for five years he severed his connection with the service, but reentered on September 30, 1891, and continued therewith until his death.

Always a capable, energetic, and conscientious public servant, Mr. Outram continued to discharge his duties with accustomed fidelity and exceptional courage long after his physical condition clearly foreshadowed his death. By his demise the Bureau has lost a valuable official, whose integrity and earnestness of purpose justly gave him an enviable standing in the community that he served. His pleasing personality greatly endeared him to his fellow workers and his death will be sincerely mourned.—*J. B.*

[1] This "Houston tornado" is evidently the storm described by Mr. G. A. Oberholzer in the June Review.—EDITOR.